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J*
- (b) material filling the gaps between the metal lines and having a height and one or more vertical portions;
  - (c) a protective layer formed over the metal lines and the material, wherein the protective layer covers at least one vertical portion of the material;
  - (d) a dielectric layer formed over the protective layer;
  - (e) one or more vias etched in the dielectric layer;
  - (f) a metal within the vias;
  - (g) a second metal layer formed over and in direct contact with the dielectric layer; and
  - (h) one or more openings in the protective layer for allowing the metal in the vias to contact the metal lines.
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#### **REMARKS**

In the March 14, 2001 Office Action, the Examiner rejected claims 16-33 pending in the application. After entry of the foregoing amendments, claims 16-34 are pending in the application. Reconsideration of the previously pending claims 16-33 and allowance of all claims 16-34 is earnestly requested.

As a preliminary matter, the undersigned thanks the Examiner for the courtesy of the telephone interview conducted on June 13, 2001. As stated during the interview, the undersigned believes all pending claims are allowable over the prior art of record.

#### **35 USC § 102(e)**

Claims 16, 19, 20 and 23 stand rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 5,929,524 to Drynan *et al.* Applicants respectfully traverse this rejection.

In particular, Applicants submit that, Drynan *et al.* does not teach or suggest the use of "low-k" material as set forth in claim 16, from which claims 19, 20, and 23

depend. Although the term is well known in the art, Applicant herein amends the specification to further define "low-k". This characterization is not new material. "Low-k" material is understood by those skilled in the art of semiconductor design and manufacture as being any material having a dielectric constant (k) less than that of silicon oxide (e.g., about 3.9). Drynan discloses a boro-phosphosilicate glass (BPSG), which is not a low-k material ( $k_{BPSG} > 3.9$ ); thus, BPSG cannot be characterized as "low-k" as the Examiner suggests citing Drynan.

In view of the foregoing, Applicants submit that claims 16, 19, 20 and 23 are allowable and respectfully request Examiner to withdraw rejection of the same.

35 USC § 102(b)

Claims 28 and 29 stand rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,747,880 to Havemann *et al.* With respect to claim 28, the Examiner suggests that it is "inherent" that the structure disclosed in Havemann exhibits etch selective properties since the protective layer and second dielectric layer therein are comprised of different materials (Havemann col. 7, lines 1-8; Havemann col. 8, lines 5-9). With respect to claim 29, the Examiner further suggests that Havemann teaches an interconnect wherein the protective layer comprises a dielectric material. Applicants respectfully traverse these rejections.

In particular, Applicants submit that as to claim 28, Havemann does not teach a "protective layer [which] is configured to provide etch selectivity between said protective layer and [a] second dielectric [layer]". Rather, layers 30 and 56 in Havemann may both be fabricated from the same material (e.g., silicon dioxide) (Havemann col. 7, line 4; Havemann col. 8, line 7-8). Indeed, because Havemann teaches that layers 30 and 56 may both be fabricated from silicon dioxide; if there exists an "inherent" disclosure with respect to the fabrication of these layers in Havemann, one of ordinary skill in the art would be left to conclude that consideration of etch selectivity was either (1) not conceived of by Havemann as part of the invention, or (2) not deemed to be important or critical to the invention. Claim 28, therefore, may not be properly regarded as being anticipated by the Havemann reference under § 102(b).

30 may  
be other  
materials

Inasmuch as claim 29 depends from and incorporates all of the limitations of claim 28, claim 29 is similarly allowable over the cited reference. Applicants therefore submit that claims 28 and 29 are allowable and respectfully request Examiner to withdraw the § 102(b) rejections of the same.

35 USC § 103(a)

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. (MPEP, 2143). Additionally, the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not in Applicants' disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

Drynan et al. and claims 17, 18, 21, 22 and 24-27

Claims 17, 18, 21, 22 and 24-27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over United States Patent Number 5,929,524, issued to Drynan et al. on July 27, 1999. Applicants respectfully traverse this rejection.

Applicants submit that Drynan et al. does not teach or suggest the use of "low-k" material as set forth in claim 16, from which claims 17, 18, 21, 22 and 24-27 depend. Applicants further submit that there is no motivation or suggestion to be found in the Drynan reference, nor in the knowledge generally available to one of ordinary skill in the art, to modify Drynan or to combine Drynan with any other reference to practice the invention of claim 16. As previously stated, "low-k" material is understood by those skilled in the art of semiconductor design and manufacture as being any material having a dielectric constant (k) less than about 3.9 (e.g., the dielectric constant of the commonly used insulator, silicon dioxide). Drynan discloses a boro-phosphosilicate

glass (BPSG), which is not a low-k material; in fact, the dielectric constant of BPSG is higher than that of silicon dioxide. Thus, BPSG cannot be characterized as "low-k" as the Examiner suggests citing Drynan. Additionally, because there is no motivation or suggestion to combine Drynan with any other reference to practice the invention of claim 16, there can be no reasonable expectation of success. Accordingly, claim 16 may not properly be considered as obvious under § 103(a).

Inasmuch as claims 17, 18, 21, 22 and 24-27 depend from, further limit and incorporate all of the elements of claim 16, these claims are also allowable over the cited art. Applicants therefore submit that claims 17, 18, 21, 22 and 24-27 are allowable and respectfully request Examiner to withdraw the § 103(a) rejections of the same.

Havemann et al. and claims 30 and 31

Claims 30 and 31 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over United States Patent Number 5,747,880, issued to Havemann *et al.* on May 5, 1998. Applicants respectfully traverse this rejection.

Applicants submit that Havemann does not teach or suggest a "protective layer [which] is configured to provide etch selectivity between said protective layer and [a] second dielectric [layer]" as set forth in claim 28, from which claims 30 and 31 depend. Applicants further submit that there is no motivation or suggestion to be found in the Havemann reference, nor in the knowledge generally available to one of ordinary skill in the art, to modify Havemann or to combine Havemann with any other reference to practice the invention of claim 28. As previously stated, layers 30 and 56 in Havemann may both be fabricated from the same material (e.g., silicon dioxide) (Havemann col. 7, line 4; Havemann col. 8, line 7-8). Indeed, because Havemann affirmatively teaches that these layers may **both** be fabricated from silicon dioxide, one of ordinary skill in the art is left to conclude that consideration of etch selectivity was either (1) not conceived of by Havemann as part of the invention, or (2) not deemed to be important or critical to the invention. Therefore, there is no motivation or suggestion in Havemann to provide for etch selectivity with the selection of materials used to fabricate the protective layer and the second dielectric layer. Additionally, because there is no motivation or

suggestion to combine Havemann with any other reference to practice the invention of claim 28, there can be no reasonable expectation that the mere selection of any two materials for fabrication of layers 30 and 56 in Havemann would successfully provide for etch selectivity. Accordingly, claim 28 may not properly be considered as obvious under § 103(a).

Inasmuch as claims 30 and 31 depend from and incorporate all of the limitations of claim 28, these claims are also allowable over the cited art. Applicants therefore submit that claims 30 and 31 are allowable and respectfully request Examiner to withdraw the § 103(a) rejections of the same.

Havemann et al. and Chen et al. applied to claims 32 and 33

Claims 32 and 33 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Havemann et al. in further view of United States Patent Number 5,317,192, issued to Chen et al. on May 31, 1994. Applicants respectfully traverse this rejection.

In particular, Applicants submit that Havemann, alone or in combination with Chen et al., does not teach or suggest a “protective layer [which] is configured to provide etch selectivity between said protective layer and [a] second dielectric [layer]”. Rather, layers 30 and 56 in Havemann may both be fabricated from the same material (e.g., silicon dioxide) (Havemann col. 7, line 4; Havemann col. 8, line 7-8). Indeed, because Havemann teaches that these layers may **both** be fabricated from silicon dioxide, one of ordinary skill in the art is left to conclude that consideration of etch selectivity was either (1) not conceived of by Havemann as part of the invention, or (2) not deemed to be important or critical to the invention. Moreover, there is no motivation or suggestion to be found in either Havemann or Chen to provide a “protective layer [which] is configured to provide etch selectivity between said protective layer and [a] second dielectric [layer]”. Additionally, because there is no such motivation or suggestion to combine Havemann with Chen, or any other reference, to practice the invention of claim 28, there can be no reasonable expectation that the mere selection of any two materials for fabrication of layers 30 and 56 in Havemann would successfully

provide for etch selectivity. Accordingly, claim 28 may not properly be considered as obvious under § 103(a).

Inasmuch as claims 32 and 33 depend from, incorporate and further limit all of the elements of claim 28, these claims are also allowable over the cited art. Applicants therefore submit that claims 32 and 33 are allowable and respectfully request Examiner to withdraw the § 103(a) rejections of the same.

### **CONCLUSION**

Claims 16-34 are pending in the application. Reconsideration of the previously pending claims 16-33 and allowance of all claims 16-34 is earnestly requested. Should the Examiner have any questions regarding this Response and Amendment or feel that a telephone call to the undersigned would be helpful, the Examiner is invited to call the undersigned at the number listed below.

Respectfully submitted,



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Dated: 7/12/01

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**VERSION WITH MARKINGS TO SHOW CHANGES MADE**

**In the Specification:**

In accordance with 37 CFR § 1.121(b)(1)(iii), the following separate marked up paragraph version is provided for replacement of the paragraph at page 1, line 20, which begins 'Recently, there has been great interest to replace SiO<sub>2</sub> with low-dielectric-constant ("low-k") materials ...':

Recently, there has been great interest to replace SiO<sub>2</sub> with low-dielectric-constant ("low-k") materials having dielectric constants lower than silicon oxide (e.g., about 3.9) as the ILD in interconnect structures. It is desirable to employ low-k materials as insulators in IC interconnect because these low-k materials reduce the interconnect capacitance. Accordingly, these low-k materials increase the signal propagation speed while reducing cross-talk noise and power dissipation in the interconnect.

**In the Claims:**

In accordance with 37 CFR § 1.121(c)(1)(ii), the following separate marked up rewritten claim version is provided for replacement of claim 21:

21. (amended) The interconnect of claim 16, wherein the protective layer includes silicon [carbon]carbide.